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The value of improved water supply to microenterprises in sub-Saharan Africa: The case of Wobulenzi and Lugazi, Uganda

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1. Introduction

Over the past three decades, the development of micro and small enterprises (MSEs) has gained support as a strategy for achieving broad-based economic development in less developed countries (LDCs).[1] MSEs are thought to be appropriate mechanisms for economic development of LDCs because they provide self-employment opportunities for the poor; rely primarily on labor-intensive, rather than capital intensive, technologies; capitalize on and promote development of local human capital; provide economic opportunities for indigenous people and women; and encourage "bottom-up" development approaches (Miller *et al.*, 1990). MSEs also help draw persons employed in agriculture (typically a large proportion of a LDC's workforce) into more skilled and productive activities. Economic development led by MSEs is also thought to reduce dependence on direct foreign investment; to reduce vulnerability to world prices (Biggs *et al.*, 1996); and to help alleviate population pressures on large urban areas by creating economic opportunities in secondary or market towns.

Growth in the MSE sector has been exceptional in many developing countries, including those in south and east Africa. Mead (1994), for example, found that, during the period 1981-1990, 40% of new employment in five sub-Saharan African countries—Botswana, Kenya, Malawi, Swaziland and Zimbabwe—was attributable to small enterprises. Among all less developed countries, some estimates suggest that one quarter of all people of working age are employed by MSEs (Mead, 1998).

Despite the growing number of MSEs in developing countries, very little is known about the ways in which MSEs grow and change over time (McPherson, 1996). In sub-Saharan Africa, this deficit is particularly important given mounting evidence that, although proliferating, MSEs appear to face difficulties in expanding their business. For example, Mead's 1994 study concluded that 75-80% of employment growth in the sector between 1981 and 1990 could be attributed to new MSE start-ups, rather than to expansion of existing firms. Indeed, less than one quarter of MSEs in the countries studied were able to add one or more workers to their staff over the same 10-year period. This and other research in the region suggests that barriers to entry into MSE activities are few, but the opportunities for firm growth are severely limited.

If governments and aid agencies are to help relieve constraints to MSE growth in developing countries, it is essential to learn more about firms' operations and obstacles. Efforts have been made, for example, to evaluate the impact of micro-finance programs on small enterprises in sub-Saharan Africa (Barnes *et al.*, 1998). Less research has been conducted on the role that infrastructure provision plays in MSE productivity and growth. It seems logical that reliable power, transport, and water supply infrastructure promotes economic activity of all types. Little is known, however, about the value of these services to small enterprises. In a region with some of the world's lowest *per capita* freshwater availability, it is notable that no research could be found that evaluates the importance of water supply to firms. Our research attempts to contribute empirical evidence regarding this issue, using fieldwork conducted in two market towns in Uganda.

[1] Following Mead (1998), McPherson (1996), and others, for the purposes of this document a micro enterprise is defined as one with ten employees or fewer, while a small enterprise is one comprised of eleven to fifty employees.

1.1 Micro and Small Enterprises in Uganda

MSEs play an important role in the economy of Uganda: 90% of all non-farm, private sector workers—approximately 1.5 million people—are employed in about 800,000 MSEs throughout the country. Over the last five years, the sector has experienced an average annual growth rate of 20% (Republic of Uganda, 1998). In an effort to promote MSE activities, the Government of Uganda established the MSE Policy Unit (MSEPU) within the Ministry of Planning and Economic Development's Sectoral Planning Department in 1996. The MSEPU is charged with developing policy recommendations for the Ministry regarding the support of micro and small enterprises in Uganda. In 1998, the Ministry developed the first official policy document dealing with MSEs in Uganda. This policy stressed the need for creating an "enabling environment" that promotes MSE growth. Specific items for action include increasing MSE access to credit and savings facilities; developing training and extension programs; and promoting investment in physical infrastructure, including water supply.

In an effort to better understand the importance of improved water supply to MSEs in Uganda, we interviewed owners and managers of MSEs in two towns during January, 1999. The town of Wobulenzi undertook a project in 1997-1998 that dramatically improved the quality of water supply service. Residents of a second town, Lugazi, still rely on traditional surface water sources. We were thus able to explore differences in the operations and profitability of MSEs between the two towns. Our conversations with firms in Wobulenzi also allowed us to assess the effect of improved water supply infrastructure.

In the following section of this paper, our research design and analytical framework are presented, along with a description of the study sites and field activities. Section 3 provides a characterization of MSEs interviewed for this study, and Section 4 lays out the existing "enabling environment" for firms in the towns we visited. In Section 5 we examine the impacts of improved water supply on firms in Wobulenzi and their demand for further service improvements. Demand for improved services by MSEs in Lugazi is the subject of Section 6. A discussion of our findings, their relevance for both small enterprise support and water infrastructure planning, and directions for future research comprise the concluding Section 7.

2. Research design and study sites

The objectives of this research were (1) to determine current patterns of water use and levels of expenditure on water supply by MSEs in the towns of Wobulenzi and Lugazi;
(2) to develop and test a methodology for use in assessing the value of improved water supply to small enterprises in sub-Saharan Africa; and (3) to explore the impacts of improved water supply service on the operations of MSEs in Wobulenzi. A literature review yielded very little information about the ways in which developing country MSEs use water, and none was found describing water use by small enterprises in sub-Saharan Africa. Nor was it possible to find any

studies of the value of water supply to firms in the region. For this research we thus developed a methodology that incorporated aspects of firm survey and contingent valuation research.[2]

Our analytical approach to assessing the impact of improved water supply on MSEs in the towns of Wobulenzi and Lugazi is based on the standard economic theory of the firm. Water supply is viewed as one of many inputs used by a firm to produce goods and services. As such, changes in its price are expected to have both short-term and long-term effects on firm operations (Table 2-1). *A priori*, we expect that the type of water supply improvement program undertaken in Wobulenzi—one which provided firms and households the opportunity to obtain water piped to public kiosks by the 20-liter jerrican, or through private water connections—will result in a lower price per unit volume of water for firms (and households); that firm employees will spend less time fetching, storing, and treating water; and that increased service reliability will reduce firm investments in water treatment and storage. In the short run, firms can adjust the mix of inputs to take maximum advantage of these cost savings. Over the long term, we also expect firms to adjust their capital assets and technology used in production to reach new cost-minimizing levels.

Table 2-1: Potential impacts of improved water supply on MSEs

	Short-run	*Long-run*
Decreased Production costs	Reduced expenditure on water supply, storage, and treatment Less time needed for water collection Variable input mix adjusted to new cost-minimizing levels	Increased savings invested in more efficient technology (technical change) Capital stock adjusted to new cost-minimizing levels
Increased output quantity	MSEs reduce prices and increase sales as supply curve for product shifts downward More reliable water supply leads to fewer shutdowns	Increased savings invested in capacity expansion Increased profitability attracts new MSEs into the sector
Increased product price	Demand curve for product shifts upward as households' disposable income increases	High quality, reliable water supply enables MSEs to make products commanding higher prices.

Decreased expenditures on water supply should also, in the short term, allow firms to pass on cost savings to consumers in the form of price reductions. This effect, along with increased reliability of supply, is expected to increase firm production. Over the long term, savings on water supply increases firms' ability to save for expansion, and might also attract new entrants into the sector.

Finally, over time we expect improved water supply to allow producers to increase their product prices, as households also enjoy reductions in water expenditures and thus have greater disposable income. In addition, firms should respond to the availability of low-cost, high quality

[2] An overview of the firm survey methodology can be found in Stone, A. (1992). For more information on the contingent valuation method, see Mitchell, R. and R. Carson (1989).

water both by shifting production toward new goods and services that utilize this input and by producing higher-quality forms of existing products.

Because our investigation took place roughly 18 months following the construction of a piped water system in Wobulenzi, our data speak primarily to the short-run impacts hypothesized in Table 2-1. To the extent possible, however, we will present evidence regarding all of these effects in Sections 5-7. Note that the potential benefits to firms of reduced morbidity and mortality associated with improved water supply are beyond the scope of this investigation. No attempt was made to estimate possible health-related impacts of water infrastructure investments.

2.1 Study sites

The two towns chosen for this investigation are comparable in many respects, with the exception of their water supply situations. Wobulenzi and Lugazi have similar population sizes; are roughly equidistant from the capital city, Kampala; serve as major trade centers for their respective districts; and have no significant cultural or ethnic differences. At the same time, the town of Wobulenzi has a piped water system, with the majority of firms and households served by public kiosks located throughout the community, while Lugazi still relies on traditional surface water sources. A list of prices for common goods at the time of our study is provided in Table 2-2. The similarity in prices for most items suggests that basic economic conditions facing enterprises are quite similar in the two towns.

Table 2-2: Average prices and wages in January, 1999
Ugandan Shillings and (US dollars)

	Wobulenzi	Lugazi
1 bottle of Coke	420 (0.32)	460 (0.33)
1 bottle of local beer	1015 (0.77)	1003 (0.76)
1 pack of cigarettes (10)	1080 (0.82)	950 (0.72)
1 kilogram rice	900 (0.68)	910 (0.69)
1 kilogram beef	2010 (1.52)	2140 (1.62)
1 live chicken	3615 (2.74)	4080 (3.09)
1 kilogram sugar	990 (0.75)	960 (0.73)
1 bottle cooking oil (0.5 L)	820 (0.62)	950 (0.72)
1 kilogram flour	950 (0.72)	805 (0.61)
1 loaf bread (small)	725 (0.55)	715 (0.54)
10-minute taxi ride	380 (0.29)	460 (0.35)
Unskilled daily Wage rate	2085 (1.58)	2240 (1.70)

Wobulenzi

A town of approximately 18,000 residents, Wobulenzi is located 48 km north of Kampala in the Luwero district. The major highway between Kampala and the Northern Region of Uganda runs through the center of the town and renders Wobulenzi the trading center of the Luwero district. The town is divided into the West, Central and East parishes. Most of the trading development is in the Central zone.

The main economic activities of the town's residents include coffee cultivation and processing, maize processing, and gin production. MSEs also support a significant proportion of households. A 1994 socio-economic survey found the principal occupations of residents to be commerce/trade (48%), un- and semi-skilled labor (19%), and farming (13%) (ACE, 1994). The center of town is a mixed commercial-residential zone consisting of two lodging houses, two petrol stations, and many retail shops and restaurants. There is also a small traditional marketplace. Wobulenzi has electricity and telephone service, as well as a post office.

The land in Wobulenzi is owned by a handful of private landlords. Recently, however, a significant proportion of the land has been divided into plots and is being sold to individuals. Approximately 60% of the population are homeowners. In 1996, 85% of the population reported a household income of less than 100,000 Shs. (76 USD) per month (ACE, 1994).[3]

Wobulenzi's water supply service has changed dramatically in the last two years. Installation of a piped water system was completed in 1998 under the auspices of the government's Rural Towns Water and Sanitation Programme. Previously, residents depended primarily on seven boreholes, two springs, one small piped system in the northern part of town (Luzzi Zone), and several unprotected surface sources (*e.g.*, swamps). The project introduced a new piped system with 31 kiosks throughout town where water is sold in 20-liter jerricans.

The kiosk system uses untreated groundwater extracted with electric-powered pumps. The Wobulenzi Water Authority manages the piped network while neighborhood water user groups manage the day-to-day operations of the kiosks. Each kiosk is staffed with an attendant and is generally open during daylight hours (7:00 am to 8:00 PM). The price of water from the kiosks is 25 Shs. (.02 USD) per 20-liter jerrican. Individual households and firms are also able to install private water connections at a cost of approximately 250,000 Shs. (190 USD),[4] although only about a dozen connections have been completed thus far. There is no sewage collection system in Wobulenzi; most residents have conventional (75%) or traditional (16%) pit latrines.

Lugazi

Lugazi is located 43 kilometers east of Kampala in the Mukono District on the main highway between the cities of Kampala and Jinja. The town has approximately 22,000 residents with an average population density of 800 persons per square kilometer. The main economic activities in the area are the cultivation and processing of tea and sugar cane. There is a mixed commercial-

[3] During the period January 1999, the exchange rate for the Ugandan Shilling ranged between 1290-1370 to 1 USD. The conversion rate of 1320 Shs.=1 USD is used for all calculations in this document.

[4] Costs can be higher for firms and households located a significant distance from the network pipes.

residential town center, which includes a central marketplace, a few lodging houses, petrol stations, garages, and restaurants. In general, commercial activity in Lugazi is somewhat more active as compared to Wobulenzi. Lugazi also has a bank, post office and health clinic, as well as electricity and telephone service.

Most of the property in Lugazi is either owned by or leased from just two large families, Mehta and Kulubya, which control the town's large sugar cane and tea plantations, respectively. Data from a 1994 socioeconomic survey indicate that roughly one third of Lugazi's population lives in rent-free housing within labor camps managed by these plantations. Of the remaining two-thirds, only 14% live in owner-occupied housing. Forty two percent live in private, rented housing. Less than half of households have electricity for lighting. Ninety two percent of the population cook either with firewood (38%) or charcoal (53%). Twenty five percent of the population of Lugazi is illiterate (McClelland *et al.*, 1994).

There is no piped water system in Lugazi. Households in the plantation labor camps receive water supply and other services free of charge from their employers. In the rest of the town, the majority of residents in Lugazi fetch their water from springs (56% in the dry season and 38% in the rainy season). Another 41% obtain their water from vendors in the dry season (29% do so in the rainy season) at a cost of 125-150 Shs. (.09-.11 USD) per 20-liter jerrican. A handful of residents obtain their water from handpumps and boreholes, or collect rainwater. There is no sewage collection system in Lugazi. Most residents rely on some form of pit latrine.

2.2 Field activities

Our research was conducted over a three-week period in January 1999. Seven university-educated men and women from Kampala were hired to serve as enumerators for the study. An experienced Ugandan social science researcher served as collaborator and field supervisor. During the first week, semi-structured survey instruments were developed and pre-tested for each of the communities studied. Enumerators participated actively in survey development, revision and translation, and also received intensive training in survey administration. Role plays and survey pre-testing in suburbs and small towns around Kampala were used both to refine the survey instrument and to hone enumerators' skills.

During the second week, the team traveled to Wobulenzi where a total of 184 firm surveys were completed with enterprise owners and senior managers. Local representatives assisted enumerators by facilitating introductions with local businesses and encouraging firm owners to cooperate with requests for interviews. Enumerators completed an average of seven surveys per day for five days, and were refused interviews by just 4% of potential respondents. During the final week of field work, the study followed a similar approach in Lugazi. Enumerators interviewed an average of eight firms per day for four days for a total of 176 surveys. Approximately 6% of potential respondents refused to participate in an interview.

A similar sampling strategy was used in both towns: each enumerator was assigned a particular commercial area and was instructed to interview every enterprise having fewer than 25

employees within its borders, with the exception of water vendors.[5] The team thus moved through the main commercial districts of both towns in a progressive pattern, with the aim of 100% coverage. Enumerators were instructed to attempt an interview with firm owners, but were permitted to interview senior managers in the event that an owner was unavailable.

The survey instrument used in each town included eight sections. In the first, general information about the firm was collected (*e.g.,* type of business, number of workers, days/hours of operation, age). The second obtained information about respondents' perceived constraints to their firms' growth. Next, data were collected concerning services used by the firm (*e.g.*, communications and electricity). The fourth section included detailed questions about firms' current water use and storage practices. In the fifth section, respondents were asked about their willingness to pay for improved water supply service. The sixth section comprised detailed questions about the firms' costs and revenues, investments, and access to credit. In the seventh section, information about the respondent (*e.g.*, age, business experience, education) was collected. Finally, a series of de-briefing questions was included in the eighth section, where enumerators recorded their perceptions about each interview and respondent.

Each survey was administered during an in-person interview between an enumerator and respondent. In an effort to ensure anonymity and confidentiality, no identifying information about the respondent or his/her firm was recorded during the interview. In addition, enumerators were trained to allow interruptions in the interview in the event that customers required the attention of the respondent. As a result, roughly 5% of interviews took two hours or longer to complete; the median length of interview was 75 minutes in each of the towns.

3. MSE characteristics in Wobulenzi and Lugazi

The majority of businesses interviewed sell a variety of dry goods (*e.g.*, cloth and ready-made clothing, household utensils, stationery, bicycle parts) and foodstuffs (*e.g.*, milled grain, dried tubers and legumes, processed food and baked goods). A significant proportion also provide services such as bicycle and electronic equipment repair, photo processing, and health and beauty services. The profile of the two firm samples is quite similar (Table 3-1), suggesting that the conditions facing enterprises are comparable in the two towns.

At least 97% of firms interviewed in each town are open at least six days a week, twelve hours per day. Virtually all firms reported year-round operation. As with the majority of Ugandan MSEs, most of the firms interviewed in Wobulenzi and Lugazi have only one or two employees (including the owner in owner-operated enterprises) (Figure 3-1). The median number of workers in each town was two, although in many cases a firm was staffed only by its owner. The Lugazi sample does contain a handful of larger firms (7 or more employees) as compared to the Wobulenzi sample. It is also fairly common for businesses to be attached to private dwellings; 20% of firms interviewed in Wobulenzi and 29% of those surveyed in Lugazi are physically

[5] Water vendors—self-employed individuals who fetch water and deliver it to homes and businesses—are prevalent in both towns, but particularly in Lugazi. As we have previously researched the water vending business in Lugazi, we elected to focus our limited time and resources in this study on other business types. For more information about water vending in this region, see McClelland *et al.,* 1994.

Table 3-1: Percentage of business type surveyed

	Lugazi	Wobulenzi
Retail, foodstuffs	32.3	29.4
Wholesale, foodstuffs	1.1	1.1
Retail & wholesale foodstuffs	2.3	1.6
Retail, dry goods	28.1	29.4
Wholesale, dry goods	3.4	1.6
Retail & wholesale dry goods	0.6	0.5
Services	20.2	23.3
Restaurant/lodge	10.1	12.5
Petrol station	1.7	0.5

Figure 3-1: Percentage of MSEs with indicated number of workers (paid and unpaid)

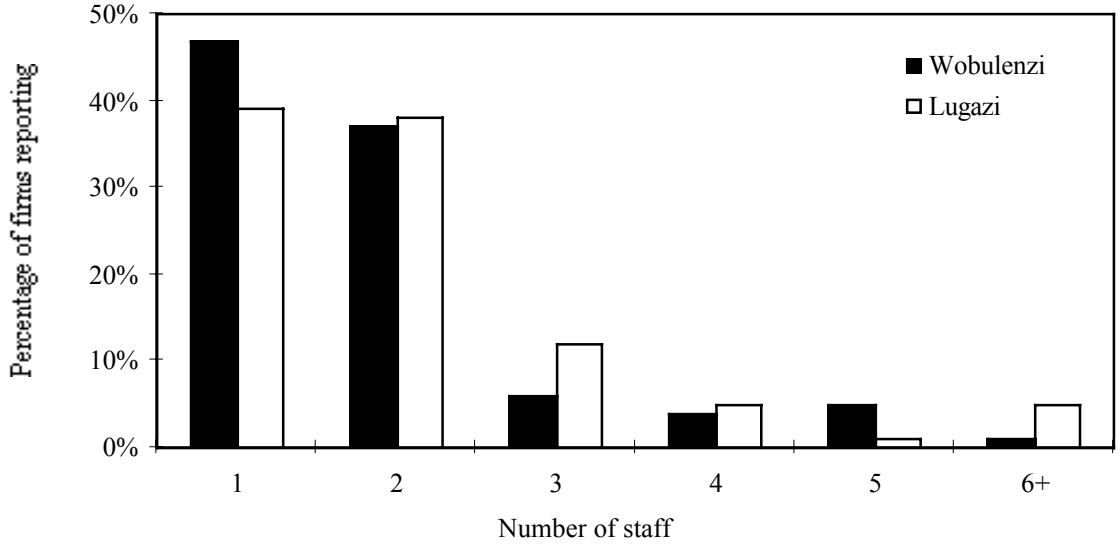
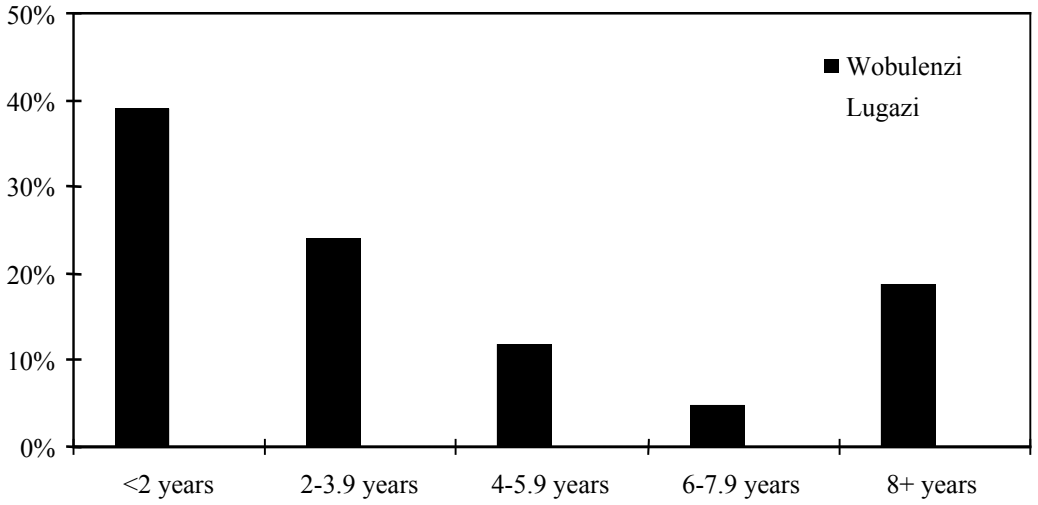


Figure 3-2: Age of MSEs surveyed (% of sample)



associated with households. At the same time, more than 95% of MSEs interviewed in each town were operating on rented land.

Approximately 40% of the firms surveyed in each town have been operating for two years or fewer (Figure 3-2). Twenty-one percent of enterprises in Wobulenzi and 12% in Lugazi are eight years or older. The median age of firms is three years in Wobulenzi and two years in Lugazi.

Survey respondents were firm owners or senior managers; at least one half of those interviewed in each town were women (Table 3-2). In both towns, the median age of respondents was 31 years. More than 95% of respondents in both towns reported having attended school; 9% completed only one to four years of education, while almost one quarter completed at least 12 years. The median number of years' business experience among respondents in both towns was four.

Table 3-2: Profile of survey respondents

	Wobulenzi	Lugazi
Percentage firm owner/co-owner/ owner's spouse	76.1	63.0
Percentage firm manager	23.9	37.0
Median respondent age	31.0	31.4
Percentage female respondents	62.3	52.0
Percentage with 0-4 years' schooling	8.9	8.6
Percentage with 5-7 years' schooling	23.3	30.9
Percentage with 8-11 years' schooling	44.4	37.1
Percentage with 12+ years' schooling	23.4	23.5

3.1 Costs, Revenues, and Profits

Enumerators obtained information about firms' costs, revenues, and level of capitalization in a variety of ways. The majority of respondents do not maintain written accounts for their businesses. To calculate monthly revenues, enumerators first asked each respondent to estimate the value of his/her firm's sales in a typical week. This figure was multiplied by four and discussed with the respondent. Later in the interview the respondent was also asked to list the three principal goods and/or services produced by the firm, and the revenues generated by each one during the past week. The enumerator totaled these revenues and compared them to the weekly figure provided in the earlier survey question. Discrepancies were discussed with the respondent and extensive discussion was undertaken to reach a final revenue estimate.

To obtain information about business expenditures, enumerators reviewed a list of typical expenditures with each respondent. These included rent, regular and casual labor, services such as electricity and water supply, formal and informal fees, and goods for resale. Capitalization estimates were obtained simply by asking each respondent how much money would be required to set up his/her firm as it was at the time of our study.

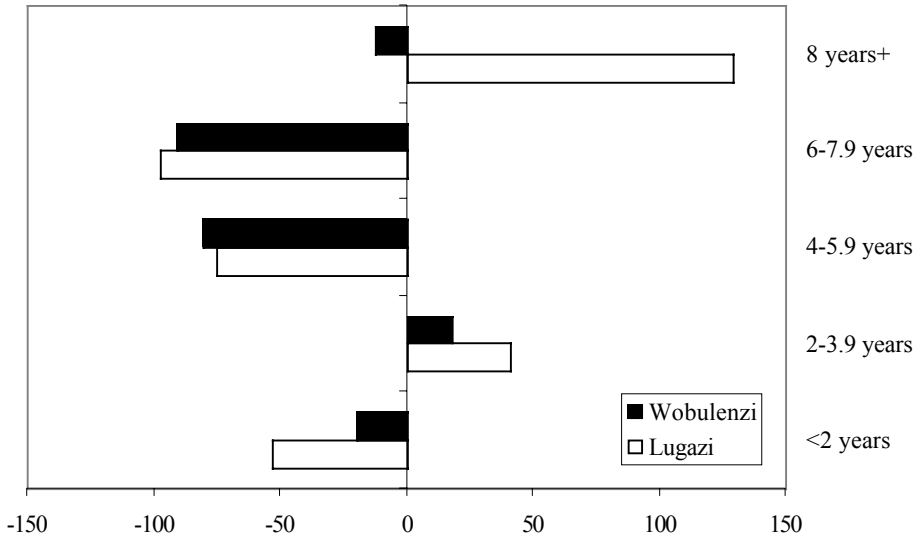
The mean and median values for reported monthly revenues, profits, and level of investment are quite similar for the two samples (Table 3-3).[6] The negative median monthly profit values speak both to the challenges inherent in collecting unrecorded, sensitive financial data from firm owners, as well as to the challenging economic conditions firms in both towns face. As Figure 3-3 suggests, the typical MSE in these town struggles to earn a profit. The median reported monthly profit is positive for firms in only two age categories—those who have recently survived initial startup (in both towns) and those enduring after eight years (in Lugazi only).

Table 3-3: Monthly revenues, profits, and investment levels of firms
Ugandan Shillings and (US dollars)*

		Monthly Revenue	Monthly profit	Capitalization
Wobulenzi	Median	976,800 (740)	92,400 (70)	1,320,000 (1000)
	Mean	356,400 (270)	-26,400 (-20)	3,036,000 (2300)
Lugazi	Median	396,000 (300)	-52,800 (-40)	1,320,000 (1000)
	Mean	1,280,400 (970)	79,200 (60)	2,468,400 (1870)

*Four firms--all petrol stations--were deleted from this analysis as their revenues, profits, and capitalization figures are significantly larger than the other firms in our sample.

Figure 3-3: Median reported monthly profit (1000s of Shs.) by age category



[6] The large mean revenue values for each town reflect the influence of two or three large firms, notably the petrol stations.

The majority of the firms' costs are those associated with obtaining goods for resale (48% of total costs, on average, for Wobulenzi firms and 51% of costs for Lugazi firms). To explore the relative levels of other expenditure categories, Table 3-4 includes the percentage of total costs represented by each category, exclusive of goods for resale. Note that the median expenditure on water supply by Lugazi firms is 3.5 times that of Wobulenzi firms, by far the greatest factor difference between the towns for any input.

Table 3-4: Percentage of firm expenditures allocated to indicated category
(Goods for re-sale excluded)

	Wobulenzi		Lugazi	
	Mean	Median	Mean	Median
Rent	25.8	17.3	30.6	29.3
Labor	14.4	10.9	17.0	10.2
Raw materials	18.2	0.0	9.4	0.0
Transportation	12.6	4.4	14.0	8.1
Formal fees	4.8	1.8	5.8	3.7
Packing materials	4.8	1.0	5.7	1.9
Electricity	4.9	2.2	4.3	2.7
Water supply	**2.6**	**1.1**	**7.3**	**4.2**
Services	3.4	0.0	2.1	0.0
Equipment	0.9	0.0	0.2	0.0
Credit	2.4	0.0	0.5	0.0
Casual labor	1.5	0.0	0.9	0.0
Other costs	1.7	0.0	0.8	0.0
Informal fees	1.1	0.0	0.6	0.0
Telephone service	0.9	0.0	0.8	0.0

4. The "enabling environment" for firm growth

As outlined in the MSEPU draft policy document on small business, promoting MSEs requires attention to a variety of support mechanisms, ranging from credit schemes to infrastructure improvements. This section provides an assessment of the current state of several enabling elements for firms in Wobulenzi and Lugazi, and then examines firms' success in expanding their businesses.

4.1 Infrastructure services

As both Wobulenzi and Lugazi are located on major highways, road infrastructure is of high quality. In each town, a tarmac road serves the central commercial district and a few paved secondary roads extend from the main artery. In addition, 71% of the MSEs surveyed in Wobulenzi, as well as 84% of those respondents in Lugazi, have electricity; however, service is unreliable, particularly in Wobulenzi where outages of 8-12 hours occur roughly every two or three days. More than 82% of the firms surveyed in each town do not have telephone service. The greatest difference in the towns' infrastructure endowments relates to water supply. Whereas the vast majority of MSEs interviewed in Lugazi rely on vendors to deliver the water they need, in Wobulenzi more than half of firms purchase their water from kiosks installed during the Small Towns Water and Sanitation Project (Table 4-1).

Table 4-1: Percentage of firms using indicated principal water source (dry season)

	Wobulenzi	Lugazi
Kiosks	52.8	0.0
Vendors	35.0	94.6
Standposts	4.3	0.0
Boreholes	4.3	0.6
Surface water	0.6	5.4
Private connection	1.6	0.0

4.2 Access to credit

A lack of financing opportunities is evidenced by respondents' answers to questions about their access to credit (Table 4-2). Among firms surveyed, only 6.2% in Lugazi and 13.6% in Wobulenzi reported that they currently have a loan for their business. Moreover, at least half of respondents felt that it was "unlikely" or "impossible" that they would be able to obtain a relatively modest loan (225 USD) for their business.

Table 4-2: Firms' access to financing (percentage of responses)

Question: If you wanted to get a loan of 300,000 Shs (225 USD) for your business, how easy would this be to do?		
	Wobulenzi	Lugazi
"Quite easy"	26%	21%
"Possible, but not easy"	19%	17%
"Unlikely"	17%	10%
"Impossible"	38%	52%

One would expect firms' access to credit to affect their ability to make capital investments in their business. A majority of respondents in both Lugazi and Wobulenzi said that, when their firms do earn a profit, they re-invest at least one half of those profits in their firms (Table 4-3). Only about one quarter, however, said they had been able to make capital investments during the 1998 calendar year. These ranged from modest improvements to the firm (*e.g.,* new shelves or a door) to equipment purchases (*e.g.,* a handsaw or refrigerator).

Table 4-3: Percentage of owners applying at least half of profits to indicated category (up to two responses permitted)

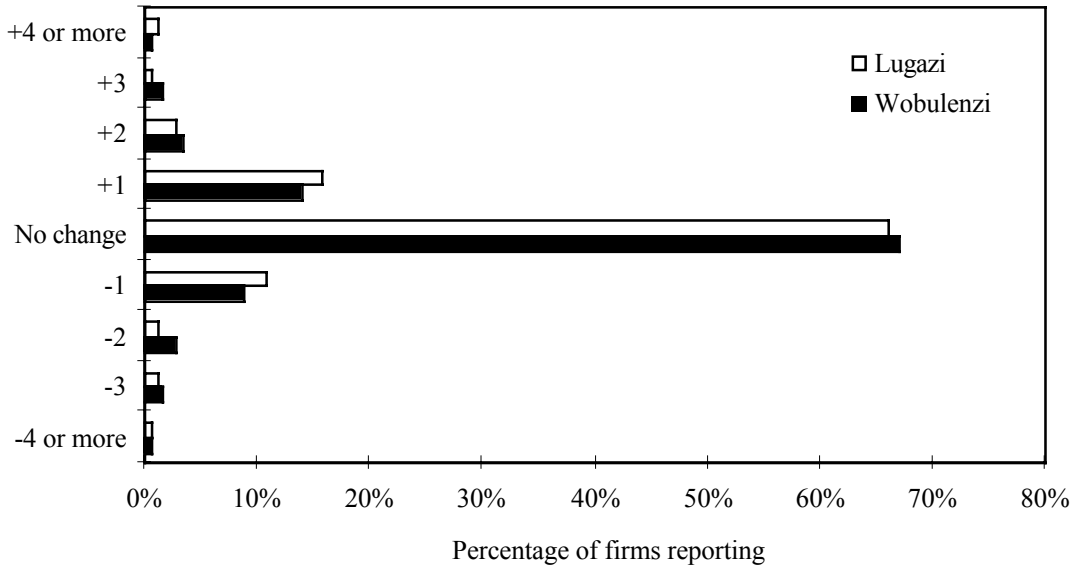
	Wobulenzi	Lugazi
Household expenses	46%	47%
Re-investing in the firm	76%	60%
Investing in another business	6%	4%
Remittances to family	6%	5%
Savings	10%	4%

Totals exceed 100% because respondents were permitted to choose up to two categories in their response.

At the same time, about one half of firms in each town said they planned to expand their businesses in the twelve months following their interview. Of these, most (64% in Wobulenzi and 56% in Lugazi) are planning to increase the range and/or volume of products they sell, but some also expect to open additional locations (17% in Wobulenzi and 13% in Lugazi) and hire

more staff (13% in Wobulenzi and 7% in Lugazi). This lattermost category of expansion is particularly important given firms' apparent difficulty in increasing their staff size (Figure 4-1). Almost 70% of all MSEs surveyed said they had the same number of workers at the time of their interview as they did when their firms opened. Focusing on staff size at these two endpoints in time could mask important growth and contraction throughout the life of the firms. However, anecdotal evidence suggests that employment in these enterprises has simply stagnated.

Figure 4-1: Change in number of workers from firm startup to present



When asked about the economic outlook for their firms, respondents had mixed opinions about the future (Figure 4-2). A small proportion felt that economic conditions for their enterprises were either "excellent" or "terrible." Most felt the business environment to be "fair" (a term connoting a slightly more optimistic opinion in Uganda as compared to other English-speaking countries), while a significant percentage said their firms' outlook is "poor."

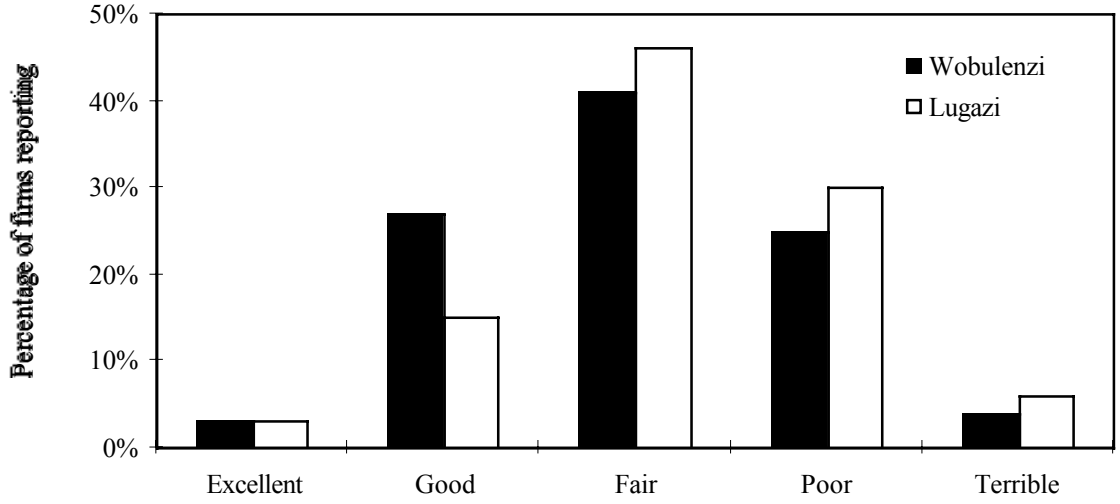
4.3 Perceived constraints to growth

After obtaining detailed information about these elements of an "enabling environment" for MSEs, enumerators asked respondents their opinion about the principal obstacles to their firms' growth. For each obstacle, respondents chose on a scale of 1 to 5 the category which best characterized the degree of constraint posed to their firm, where 1 signified "not at all a constraint" and 5 "a very large constraint." The mean responses for all owners/managers in each town are provided in Figure 4-3.[7]

[7] Standardized scores for these rankings were also computed; we found no difference in conclusions from the analysis. For ease of interpretation, the raw data are presented in Figure 4-3.

Figure 4-2: The economic outlook for MSEs

Question: Would you say the outlook for your business is...



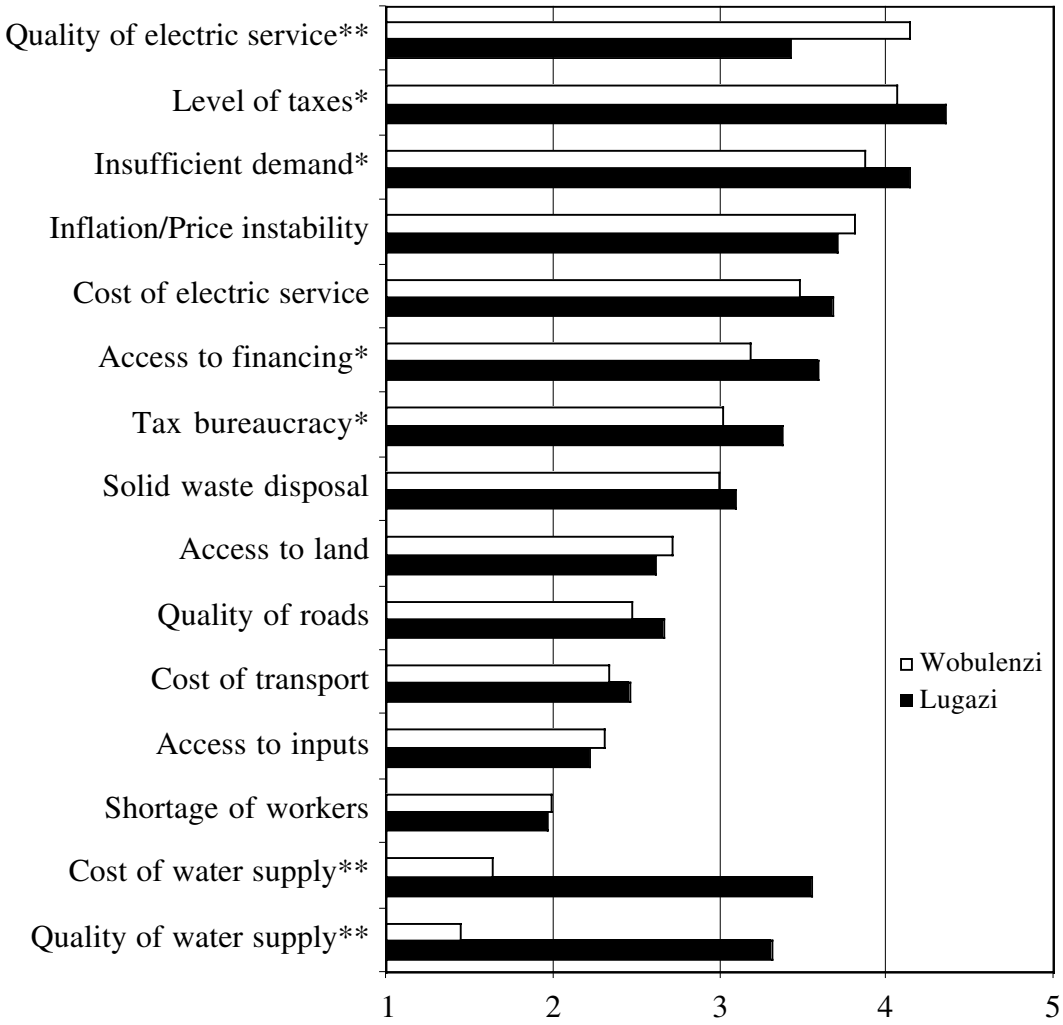
The profiles of the towns appear similar, with a few exceptions. First, the quality of electric service is seen as a principal constraint for MSEs in Wobulenzi, consistent with the frequent service interruptions described in Section 4.1. Second, tax levels and tax bureaucracy appear to be a greater concern for firms in Lugazi as compared with Wobulenzi. Although our calculations of the tax burdens on MSEs in each town seem relatively modest (2-4% of expenditures, net of goods for resale), on average Lugazi firms are paying twice the amount in taxes as firms in Wobulenzi. Comparatively high local tax rates in Lugazi appear to be the principal reason for this difference.

The most stark difference in rankings by the two samples, however, pertains to the constraint posed by water supply. Whereas the majority of Wobulenzi firms consider both the cost and the quality of water supply to be "not at all a constraint," Lugazi firms view water supply, especially its cost, as one of the greatest obstacles to their growth (6th highest, after access to financing and before quality of electric service). Note that these questions were posed in the first part of the interviews, before respondents knew that water supply was the principal focus of our investigation. It thus appears that the Small Towns Water and Sanitation Project has indeed benefited MSEs in Wobulenzi by virtually eliminating water supply as a concern.

5. The impact of improved water supply on MSEs in Wobulenzi

Although water kiosks constructed in Wobulenzi had only been operational for 12-18 months at the time of our study, we were able to document several effects of improved water service on MSE operations. One considerable impact has been the decreased cost of water supply (Table 5-1). Prior to the implementation of the Small Towns Water and Sanitation Project, firms relying on vendors for their water supply service paid an average of 175 Shillings (0.13 USD) per jerrican, roughly 17% higher than current price in Lugazi. Those who now patronize kiosks enjoy a price 86% lower than before the project. Moreover, the average price of vended water in Wobulenzi has fallen 43%; this could be a result of increased competition from kiosks, of decreased delivery costs for vendors, or both.

Figure 4-3: Constraints to MSE growth



Degree of constraint (1="Not a constraint at all"; 5="Very large constraint")

*=Means are significantly different at .05 level

**=Means are significantly different at .01 level

Table 5-1: Change in prices of water in Wobulenzi
in Ugandan Shillings and (US dollars)

Water source	Average price per 20-liter jerrican	
	Pre-project	At time of study
Kiosk	N/A	25 (0.02)
Vendor	175 (0.13)	100 (0.08)
Borehole/Standpipe	100 (0.08)	65 (0.05)

Note that the prices in Table 5-1 do not include the value of time spent obtaining water from each source, which for some individuals can be considerable. On the other hand, it is not clear how incorporating the value of time would impact these figures. More than half the kiosks in Wobulenzi are located in the central business district, and queue times were reportedly negligible at the time of our study. (Mean and median travel times to public water points in Wobulenzi are provided in Table 5-2.) Vended water requires almost no time to acquire for customers with a regular delivery arrangement. However, many respondents in our survey said that they must go out in search of a vendor when they want a water delivery, a task which can take up to one half hour.

Table 5-2: Mean, median travel time to public water points
from Wobulenzi MSEs (minutes)

Source	Mean travel time (one way)	Median travel time (one way)
Kiosks	5.4	2.0
Standposts	7.1	3.0
Boreholes	12.2	10.0

Firms in Wobulenzi have apparently responded to changes in water prices by shifting their water consumption to new sources (Table 5-3). Of the 137 firms in the survey that were operating in Wobulenzi prior to the Small Towns Water and Sanitation project, roughly one third (48) continued to use the same principal water source once the new piped system was completed (represented in the shaded diagonal cells of the table). The remaining two thirds (89) adopted new principal sources. Of these, 84% switched from their previous source to the new kiosks. All firms who relied principally on surface water sources prior to the project reported having switched to an improved water source at the time of our study.

Table 5-3: Changes in principal water source among Wobulenzi firms
Number of firms (percentage)

	Previous (pre-project) source				
	Private connection*	Vendors	Standposts	Boreholes	Surface water
Current source					
Kiosks	3 (2.2)	33 (24.1)	20 (14.6)	7 (5.1)	12 (8.8)
Private Connection	0 (0.0)	0 (0.0)	1 (0.7)	0 (0.0)	1 (0.7)
Vendors	0 (0.0)	41 (29.9)	6 (4.4)	0 (0.0)	0 (0.0)
Standposts	0 (0.0)	0 (0.0)	3 (2.2)	0 (0.0)	3 (2.2)
Boreholes	0 (0.0)	1 (0.7)	0 (0.0)	4 (2.9)	1 (0.7)
Surface Water	1 (0.7)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)

Note: Firms not operating before improved water supply deleted.
*Includes firms that obtain(ed) water from homes with connections to the old (Luzzi) system (see Section 2.1) and/or the new system.

When asked to enumerate the impacts of the Small Towns Water and Sanitation Project on their operations, more than half of firms in Wobulenzi cited improved reliability and/or reduced costs of water supply (Table 5-4). Almost one fifth said they had been able to increase output, most frequently as a result of decreased production costs. Approximately 13% said that demand for their firm's goods or services had increased. Of these, however, most attributed the increased demand to their use of higher quality water (*e.g.,* in a butcher's shop or a health clinic), rather than to households' having greater disposable income as a result of lower water prices. Finally, a small proportion of firms said they had been able to introduce new goods or services as a result of the improved water supply service. For example, several dry goods dealers said they had begun selling beverages to customers visiting their shops.

Table 5-4: Percentage of Wobulenzi firms citing indicated effect of improved water supply (multiple responses permitted)

	% citing effect
Improved reliability of water supply	56.0
Reduced expenditures on water (money and time)	55.7
Increased sales/production	18.0
Increased demand for firm's products	12.8
Production of new goods/services	8.0

These responses concur with our hypotheses regarding the kinds of impacts that improved water supply might have on MSE operations in Wobulenzi. It is equally interesting to review respondents' descriptions of particular effects and the mechanism by which they occur (Box 5-1). Time and cost savings, along with increased reliability and water quality, appear to be assisting MSEs in increasing production and investment, as well as creating new opportunities for firm expansion.

Box 5-1: Selected verbatim responses regarding the effects of improved water supply on Wobulenzi MSEs

"Now on the way to open [my business] in the morning I spend so little time getting water, I am open earlier and ready to serve my customers."—*Restaurant owner*

"We have to store less water now. We know it's easy to get it when we want it."—*Shoe store owner*

"Before, our water supply was unreliable and I had to close down to go and look for water."—*Bicycle repair shop owner*

"We still use vendors, but now they can get water much more quickly so we don't have to wait for the water."—*Retail shop manager*

"The demand for my goods has just shot up—the people have more savings, as I do."—*Housewares shop owner*

"We spend so much less money on water now. We have water all the time and we were able to buy a fridge."—*Owner of large restaurant/lodging house*

"[With the cost savings for water] I am employing more workers to ease my work."—*Restaurant owner*

"I can use more water to clean my goods and my knives. People come to my shop now because they notice how clean I keep it."—*Butcher*

Although many MSEs owners and managers in Wobulenzi said that their expenditures of time and money for water supply had decreased as a result of the Small Towns Water and Sanitation Project, it appears that firms have by and large not responded to the reduced price of water by increasing the volume of water they use. Among firms who switched from a previous source to the new kiosks, consumption increased on average by only 7% (while the median volume used remained unchanged). There is also very little difference between water use by MSEs in Lugazi and Wobulenzi, despite the significant price differences in supply (Table 5-5). In the following sections, we explore the relationship between costs and demand for water from different sources in both Wobulenzi and Lugazi while controlling for a number of potentially confounding factors.

Table 5-5: Mean, median water use per day (liters) by firm type

	Lugazi		**Wobulenzi**	
Business type	Median	Mean	Median	Mean
Retail and/or wholesale foodstuffs	20	35	20	24
Retail and/or wholesale dry goods	40	47	40	47
Services	40	44	40	39
Restaurant/lodge	120	199	100	131
Petrol station	120	107	200	200

5.1 Demand for vended water in Wobulenzi and Lugazi

As discussed earlier, vendors are the predominant source of water supply for MSEs in Lugazi, and the second most important source in Wobulenzi after kiosks. The cost of water from

vendors is largely captured by its price, while the cost of water from kiosks, standpipes, springs, and boreholes also includes collection-related labor costs (*e.g.*, paid regular or casual workers, or the opportunity cost of unpaid workers). Analyzing consumption of water from vendors thus enables us to isolate the impacts of water prices more readily. Given that the price of water from vendors is so much higher in Lugazi than in Wobulenzi, one might expect such an analysis to show that consumption of water in Lugazi is lower than in Wobulenzi after controlling for the effects of other factors affecting water consumption. We thus used data on water purchased from vendors in Wobulenzi and Lugazi to estimate water demand functions that related water consumption to water price and other pertinent variables.

Production theory implies that water demand by a cost-minimizing enterprise should be a function of the price of water, prices of other production inputs (which might be complements or substitutes for water), the enterprise's output level, and fixed characteristics of the enterprise. We had data on price of water (in Shillings per liter), and we proxied output with two variables, weekly sales revenue and weekly business hours. We did not have data on prices of other production inputs, aside from some data on labor. The labor data were too incomplete to use. However: many enterprises in both towns had only a single, unpaid worker (the owner-operator), and we had no information on the shadow wage rate for such workers.

To capture differences in fixed characteristics of enterprises, we included dummy variables for business type: foodstuffs, dry goods, services, restaurants, clinics, and petrol stations. We also estimated separate demand equations for the first four business sectors, which each contained a large number of enterprises. We controlled for possible non-business (*i.e.,* household) use of water by including both a dummy variable for enterprises that reported using water in their production process and a variable for households attached to MSEs. Finally, we included a dummy variable for enterprises that reported treating their water.

In sum, we estimated demand functions of the form:

$$\begin{aligned}\text{Water use} = \; & \beta_0 + \beta_1 \text{ Water price} + \beta_2 \text{ Weekly sales revenue} + \beta_3 \text{ Weekly business hours} + \\ & \beta_4 \text{ Number of household members (if dwelling attached)} + \\ & \beta_5 \text{ Dummy variable if enterprise uses water in production} + \\ & \beta_6 \text{ Dummy variable if enterprise treats water,}\end{aligned}$$

with dummy variables included for type of business in the cross-sector demand equation. Table 5-6 presents the results of this analysis. As expected, the coefficients on the measures of enterprise output (weekly sales revenue and business hours) are positive and statistically significant in many cases, but the coefficient on the price variable is not significant in any equation.

The lack of a significant price effect could have several explanations: measurement error, too small a difference in prices between the two towns, or enterprises in Wobulenzi not having yet adjusted to the lower prices. The last explanation could occur if the amount of water consumed per unit of output is a function of technology embodied in equipment and other capital assets, which turn over slowly. To explore this possibility, we reestimated the demand functions for a sample limited to businesses that started after 1997, when the kiosk system began operating in Wobulenzi and reduced the price of vended water. We found that the coefficient on water price

Table 5-6: Demand for water from vendors in Wobulenzi and Lugazi
(Ordinary least squares estimates)

	All sectors[a]	*Foodstuffs*	*Dry goods*	*Services*	*Restaurants*
Dependent variable	Weekly water consumption	Weekly water consumption	Weekly water consumption	Weekly water consumption	Weekly water consumption
Independent variables:[b]					
Constant	-595[†] (206)	65.1 (111)	-234 (253)	-171 (279)	-3614[◊] (1264)
Water price	22.6 (15.4)	-4.31 (9.71)	1.87 (17.0)	15.3 (21.4)	238 (190)
Weekly sales revenue	-0.00183 (0.0208)	0.00154 (0.0117)	0.00567 (0.0435)	0.714 (0.366)	2.16[†] (0.567)
Weekly business hours	6.63[†] (2.00)	0.664 (1.20)	5.78[◊] (2.30)	-0.758 (2.47)	21.0[◊] (8.47)
Number of household members (if dwelling attached)	8.05 (10.0)	-0.492 (5.74)	-11.3 (8.61)	36.8[*] (18.4)	26.6 (33.3)
Dummy variable: Enterprise uses water in production	-38.2 (84.3)	63.1 (38.7)	-15.7 (82.6)	299[*] (173)	-
Dummy variable: Enterprise treats water	148[*] (77.6)	132[†] (37.0)	114 (98.4)	114 (84.5)	681 (744)
R^2	0.384	0.240	0.171	0.417	0.830
Standard error of regression	482	144	258	216	744
Number of observations	219	75	68	34	20

[a] Standard errors in this equation have been corrected for heteroskedasticity. Dummy variables for type of business are not shown.
[b] Standard errors are given in parentheses under coefficient estimates. Significance levels: [*] = 10%, [◊] = 5%, [†] = 1

was negative in the demand functions for three of the four types of businesses (foodstuffs, dry goods, services), compared to only one (foodstuffs) in the sample for all years combined. None of the three coefficients was significant, however, and the coefficient on water price in the demand function for all types of businesses combined was positive.

5.2 Demand for water from all sources by Wobulenzi MSEs

Whereas the price of vended water varies little within Wobulenzi, the price of water varies substantially across different sources (see Table 5-1). Of course, the lower prices for boreholes, kiosks, and standpipes are to some extent offset by the monetary or opportunity cost of labor required to fetch water from those sources. We therefore had reason to expect that price variation might be sufficient within Wobulenzi to affect water consumption, but we had to control for the labor-related costs of collection from sources other than vendors. We did the latter by including variables measuring proximity to water source in terms of either distance (meters) or time (minutes). Respondents provided distance information in only one (not both) of these forms. Otherwise, the demand equations had the same specification as above.

Table 5-7 shows the results of this regression analysis. The coefficient on water price was again statistically insignificant in all equations. The coefficient on minutes from source was, however, significant at the 5% level for all businesses combined and for dry goods sellers. The magnitudes of the impacts on water consumption were very small: the elasticity (percent change in water consumption for a 1-percent increase in minutes) was only –0.0447 for all businesses combined and –0.0909 for dry goods. We conclude that proximity of water source does influence the volume of water used by Wobulenzi firms, but this effect is slight.

In order to test for the existence of other factors that might cause consumption of water by MSEs using kiosks to differ from consumption of water by MSEs using other sources, we added a dummy variable for businesses whose principal source was kiosks and re-estimated the equations. With one exception, the coefficients on this dummy variable were not statistically significant, and the coefficients on other variables changed very little from the values in Table 5-6. The exception was the water demand function for businesses selling foodstuffs. The coefficient on the kiosk dummy variable in this equation was marginally significant (t statistic=1.76, degrees of freedom=32). Surprisingly, it had a large, negative value, -80.7, *e.g.,* weekly water consumption was on average 80.7 liters less for shops that sourced their water from kiosks than for shops that relied on other water sources. The addition of the kiosk dummy variable also changed the sign of the coefficient on the water price variable from positive to negative (-2.69), but it remained statistically insignificant (t statistic=0.324). It appears that the introduction of kiosks has affected businesses selling foodstuffs in a different way than other business types, but the reasons are not clear. Again, the findings of this analysis may be the result of the short time lapse between the completion of kiosk construction and our investigation. On the other hand, Wobulenzi firms' behavior are consistent with evidence from other research into household water use that water consumption does not rise dramatically until households obtain

Table 5-7: Demand for water from all sources by Wobulenzi firms
(Ordinary least squares estimates)

	All sectors[a]	*Foodstuffs*	*Dry goods*	*Services*	*Restaurants*
Dependent variable	Weekly water consumption	Weekly water consumption	Weekly water consumption	Weekly water consumption	Weekly water consumption
Independent variables:[b]					
Constant	-230† (88.2)	10.0 (84.3)	-354* (192)	-104 (174)	-77.0 (314)
Water price	7.60 (7.29)	6.33 (6.73)	-10.6 (11.9)	23.0 (13.7)	-43.5 (35.4)
Minutes from source	-12.8$^{\diamond}$ (5.07)	-2.22 (4.88)	-21.6$^{\diamond}$ (9.37)	8.09 (16.6)	0.498 (36.3)
Meters from source	-0.0817 (0.241)	0.0288 (0.483)	-0.444 (0.360)	0.676* (0.367)	0.0347 (0.347)
Weekly sales revenue	-0.00828 (0.00701)	-0.0103 (0.00718)	0.108* (0.0633)	0.453* (0.263)	1.93† (0.496)
Weekly business hours	3.40† (1.12)	0.719 (1.16)	5.60† (2.06)	-0.268 (2.44)	6.08$^{\diamond}$ (2.58)
Number of household members (if dwelling attached)	14.4* (8.16)	1.53 (5.16)	6.17 (8.37)	21.4 (14.6)	57.7† (13.0)
Dummy variable: Enterprise uses water in production	83.3$^{\diamond}$ (40.4)	77.1$^{\diamond}$ (34.6)	30.3 (68.9)	195$^{\diamond}$ (87.8)	-
Dummy variable: Enterprise treats water	124† (35.1)	116† (36.8)	234$^{\diamond}$ (92.8)	146$^{\diamond}$ (70.1)	23.5 (178)
R^2	0.615	0.462	0.460	0.572	0.824
Standard error of regression	193	96.2	205	174	164
Number of observations	148	42	49	32	21

[a] Standard errors in this equation have been corrected for heteroskedasticity. Dummy variables for type of business are not shown.
[b] Standard errors are given in parentheses under coefficient estimates. Significance levels: * = 10%, $^{\diamond}$ = 5%, † = 1%.

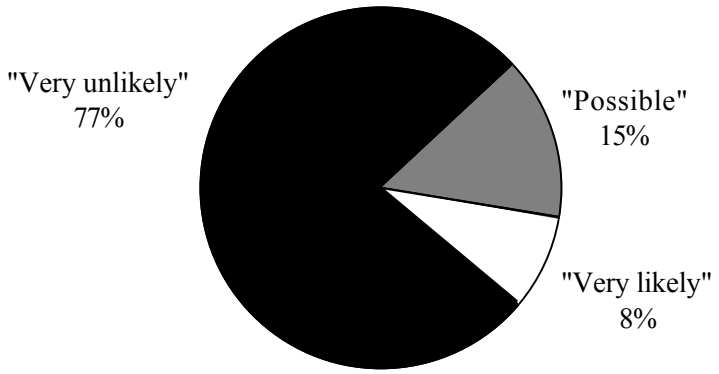
the majority of their water from private connections.[8] In the following sections, we analyze demand for this level of service among firms in both towns.

5.3 Demand for private connections

Given that the provision of convenient, low-cost public water points has apparently had a positive effect on the operations of MSEs in Wobulenzi, we might postulate that the provision of private water connections—most likely yard taps—to firms would generate even larger impacts. In fact, both enterprises and households in Wobulenzi are free to install a private connection provided they can afford the connection costs (roughly 190 USD). Monthly water bills are based on metered usage; water is priced at 1000 Shs. (0.76 USD) per cubic meter. At the time of our study, however, only two businesses had installed private connections (a petrol station still under construction and a restaurant/lodging house), and two others (a second petrol station and a childbirth center) had applied but not yet paid installation costs for a connection.

Enumerators asked the remaining firm owners and managers in Wobulenzi about their intention to install a private connection in the near future. The majority said that it was "very unlikely" or "impossible" that their firm would make such an investment (Figure 5-1). One third said the principal reason for their decision was that a private connection was prohibitively expensive; 27% cited their enterprises' location on rented property as the primary reason; 22% said that their firms did not have use for large quantities of water; and 10% said they were satisfied with their current water source.

Figure 5-1: Likelihood of installing a water connection within two years (Wobulenzi)



[8] See, for example, White (1972).

In an effort to assess demand among Wobulenzi MSEs for private connections, two contingent valuation (willingness-to-pay) scenarios were developed—one for firms operating on property they own, and one for firms on rented property. In each case, a split sample approach was used; each respondent received only one of several different prices for service. In the case of owners, we explored whether the up-front costs of installing a private connection are a significant deterrent to Wobulenzi firms by using a scenario that included one-, two-, or five-year financing of the connection fee (no such financing is currently available either through the water authority or the Small Towns Water and Sanitation Project). Specifically, respondents were told:

> As you know, it is possible for your business to obtain a private connection from the Wobulenzi Water Authority. The Water Authority sells water through the piped network for one Shilling per liter, or 20 Shillings per jerrican.
>
> Typically, it costs about 250,000 Shillings to have a private connection installed, and it all must be paid up front. Suppose, however, it were possible to obtain a private water connection for your business without having to pay the entire costs up front. Instead, you would pay [25,000 Shs. / 12,500 Shs. / 8,500 Shs.] each month for [1 / 2 / 3] years, for a total cost of about 300,000 Shs. You would also have to pay each month for the water you use, at a price of 20 Shillings per jerrican.
>
> If you could obtain a private water connection for your business under these conditions, do you think you would do so?

Only six respondents represented businesses operating on non-rented property and were posed this question. All six said they would install a private water connection if financing were provided to them. Three agreed to a monthly payment of 25,000 Shs. (18.90 USD) for one year; two agreed to a payment of 12,500 Shs. (9.50 USD) for two years; and the last to a payment of 8,500 Shs. (6.40 USD) for three years. Although caution must be exercised in interpreting such a small number of responses, their consensus suggests that a program of financing connection costs could be successful in further upgrading water supply for Wobulenzi's small enterprises.

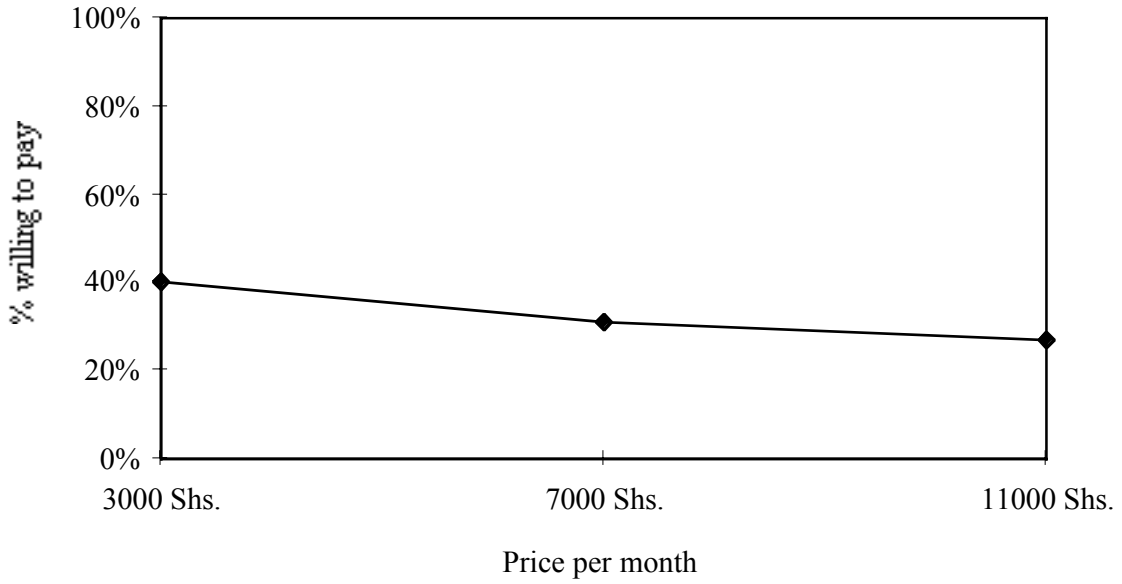
A second scenario was developed for MSEs occupying rented land, the vast majority of firms interviewed. For these respondents, enumerators asked:

> As you know, it is possible for your business to obtain a private connection from the Wobulenzi Water Authority. The Water Authority sells water through the piped network for one Shilling per liter, or 20 Shillings per jerrican.
>
> Typically, it costs about 250,000 Shillings to have a private connection installed, and it all must be paid up front. Suppose the owner of this land/building agreed to pay for the installation of the private connection, if you agreed to pay an increase in your monthly rent. Suppose this increase were [3,000 Shs. / 7,000 Shs. / 11.000 Shs.] each month that you occupied this land/building.
>
> If you could obtain a private water connection for your business by paying an increase in your rent of [3,000 Shs. / 7,000 Shs. / 11.000 Shs.] each month, do you think you would do so?

Demand for private water connections among these respondents is quite low across all prices (Figure 5-2). Even at a very low price of 3,000 Shs. (2.30 USD) per month—a price equivalent to purchasing four jerricans of water from a kiosk, or one jerrican of vended water, each day—only 40% of respondents said they would agree to a rent increase. At a price of 11,000

Shs. (8.30 USD) demand falls to roughly one quarter of respondents. When asked about their choices, few respondents said they were interested in obtaining a private connection in order to sell water to others. Indeed, when asked about this possibility, one respondent said he could not make any money with such an undertaking, as "competition is too keen."

Figure 5-2: Percentage of Wobulenzi firms willing to pay indicated monthly price (Ug. Shs.) for private water connection (renters)



6. Demand for improved water supply by Lugazi MSEs

Consistent with the finding that MSEs in Wobulenzi appear to believe that improved water supply has been a boon for their operations, firms in Lugazi expressed interest in obtaining a piped water system for their own community. Respondents in Lugazi were asked about their willingness and ability to pay for a private water connection for their business, as well as for access to a kiosk system such as the one installed in Wobulenzi. Virtually all respondents were familiar with the technologies described, despite the fact that only surface water sources are currently available in Lugazi. Many had traveled to Kampala, Wobulenzi, and/or other towns with improved water supply; others had learned about piped water service from friends or relatives. In each interview, enumerators carefully described the technology, costs, and benefits associated with both private water connections and public kiosks, ensuring that respondents fully understood the services they were subsequently asked to value.

6.1 Demand for private connections

Only nine respondents in the Lugazi sample operated firms on property they owned. For these individuals, a contingent valuation scenario very similar to that presented in Section 5.2 was used to assess their willingness to pay to acquire a private water connection. The responses were more mixed than those obtained in Wobulenzi (Table 6-1). Of the four respondents who were asked about financing their 250,000 Shs. (190 USD) connection costs over one year, three said

they would not obtain a private connection and one said she would connect. The one respondent asked about a two-year plan said he would not obtain a private connection. All four respondents who were given a scenario with three years of financing said they would accept this arrangement. Over all prices, the respondents who said they were willing to obtain a private connection all said they would use the financing scheme rather than paying the connection costs up front. Again, we should be cautious in drawing conclusions from such a small sample. However, the provision of extended financing appears to positively affect demand for improved water supply services.

Table 6-1: Demand for private connections in Lugazi (owners)

Number of responses	Monthly payment	Number of months	Number (%) who would obtain connection	Of these, number (%) who would pay up front
4	25,000	12	1 (25%)	0 (0%)
1	12,500	24	0 (0%)	0 (0%)
4	8,500	36	4 (100%)	0 (0%)

Of the Lugazi firms that operate on rented property (97% of the sample), we asked whether, if their landlord were willing to pay the initial costs for a private connection, they would be willing to pay an increased amount in their monthly rent for access to this level of water supply service (just as with the Wobulenzi renters). Their responses to this question are presented in Figure 6-1. Although demand is higher among Lugazi respondents as compared to those in Wobulenzi, the proportion of firms willing to have a private connection installed is still quite low relative to the cited prices. Only 60% of firms were willing to pay an increased rent of 3,000 Shs. (2.30 USD)—an amount less than the reported monthly water expenditures of 73% of the enterprises interviewed—to install a private water connection at their firm.

At 7,000 Shs. (5.30 USD)—roughly equivalent to firms' current median monthly expenditures on water in Lugazi—the percentage drops to 49. For a monthly charge of 11,000 Shs. (8.30 USD), only 17% of firms said they were interested in obtaining a private water connection. Over all prices, the most common principal reason cited for unwillingness to pay was the firm's limited need for water (50%), followed by expense (46%). There appeared to be little interest in the notion that being one of the first locations to install a private water connection carried the potential of significant financial gain through the re-sale of water to others.

6.2 Demand for kiosks

All owners/managers in Lugazi were also asked about their willingness to pay to use a kiosk system similar to that now operating in Wobulenzi (Figure 6-2). Firms expressed very strong demand over all prices for this level of improved water supply service. Even at a price of 125 Shillings (0.11 USD)—an amount for which vended water can be purchased in the rainy season—60% of respondents said they would use a kiosk system as their firm's primary source of water supply. When asked why they would be willing to fetch water from a kiosk for the same price needed to have it delivered to their door, respondents cited the unreliability of

Figure 6-1: Percentage of Lugazi firms willing to pay indicated monthly price for private water connection

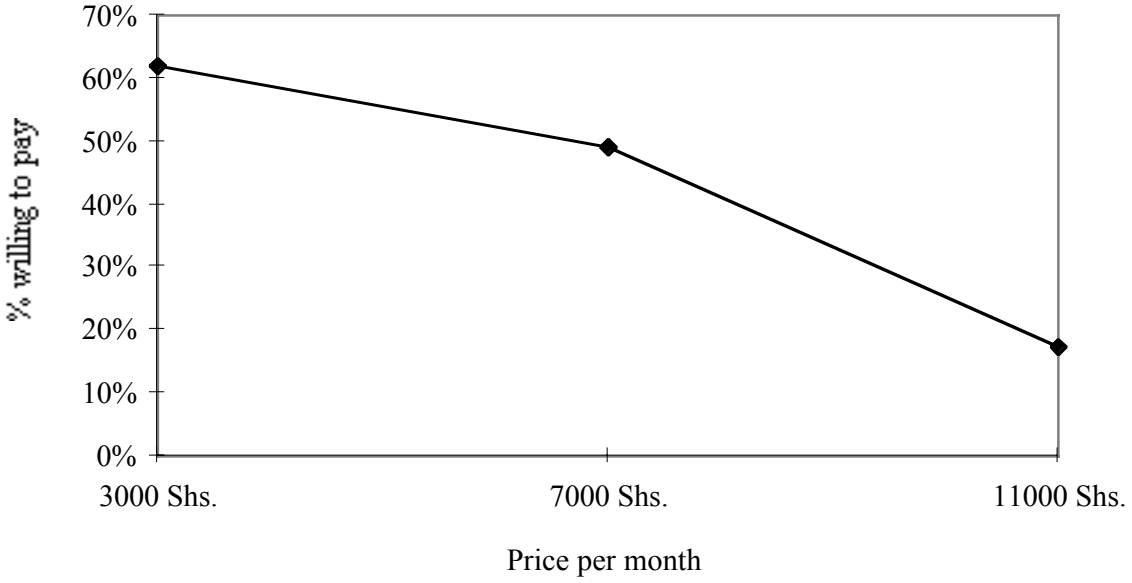
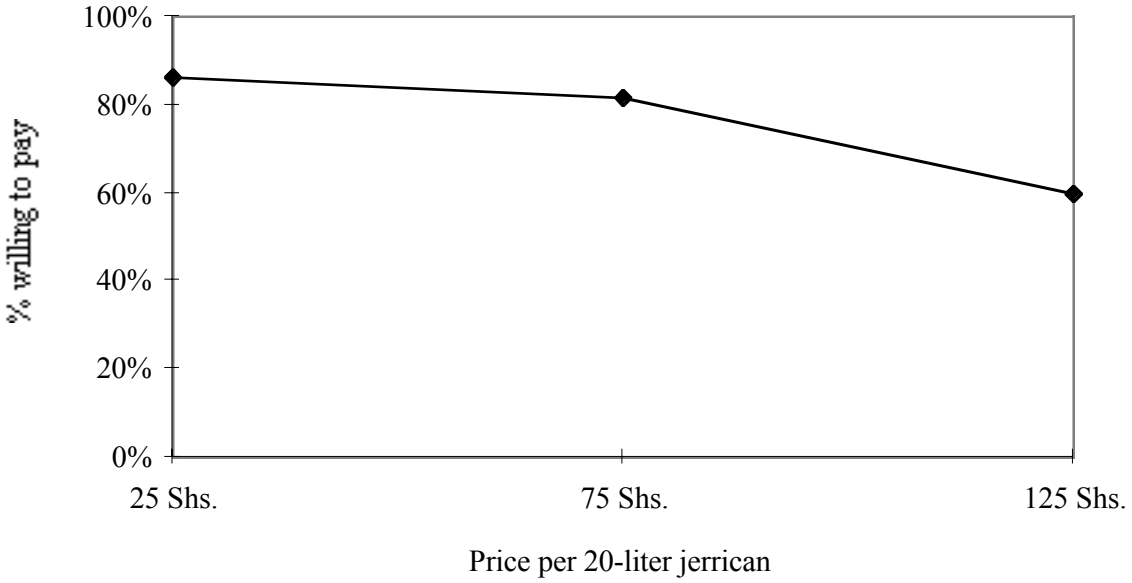


Figure 6-2: Percentage of Lugazi firms willing to pay indicated per-jerrican price for access to a public kiosk



vendors, along with their expectation that water from a piped network would be of better quality than the spring water sold by vendors.

6.3 Multivariate analysis of willingness to pay

The responses provided by firm owners and managers about their willingness to pay for improved water supply, along with characteristics of the enterprise and the respondent, were used to estimate two multivariate logit models explaining respondents' demand for private connections and public kiosks. Because so few respondents answered the first contingent valuation scenario designed for property owners, and because these individual faced a different price structure for the improved service as compared to renters, all owners were deleted from the sample for this analysis.

The first model estimated takes the form:

$$\text{Connection decision} = \beta_0 + \beta_1 \text{ Price} + \beta_2 \text{ Volume} + \beta_3 \text{ Revenue} + \beta_4 \text{ Position} + \beta_5 \text{ Gender} + \beta_6 \text{ Food} + \beta_7 \text{ Service} + \beta_8 \text{ Restaurant.}$$

The dependent variable takes the value of 1 if the respondent said s/he would be willing to obtain a private connection for the stated price and 0 otherwise. (Note that "Don't know" or "Not sure" responses are thus treated in the same manner as negative decisions.) Descriptions of each independent variable, along with its associated parameter estimate, standard error, and significance level are provided in Table 6-2. All significant parameter estimates are in the expected direction. Lower monthly rent surcharges increase the demand for a private connection; in particular, a respondent's odds of demanding a private connection increase by 1.3 for every 1000 Shs. (0.75 USD) decrease in the price. The more water a firm uses, the greater its demand for a connection; for example, for each additional cubic meter of water a firm uses per month, the odds of demanding a private connection are expected to increase by 1.5. Firms with greater monthly revenues are more likely to demand a private connection (all interpretations are net of other effects). There was no significant difference in the demand for private connections among different types of enterprises, between male and female respondents, nor between firm owners and senior managers.

The second model is identical to the first, with the exception of the dependent variable and the form of the price variable. The variable Kiosk Use takes the value of 1 if the respondent said s/he would use public kiosks at the indicated per-jerrican price and takes the value of 0 otherwise. The price variable took on one of three values (randomly assigned in different versions of the questionnaire) and represented a volumetric charge for water obtained from the kiosks.

$$\text{Kiosk use} = \beta_0 + \beta_1 \text{ Price} + \beta_2 \text{ Volume} + \beta_3 \text{ Revenue} + \beta_4 \text{ Position} + \beta_5 \text{ Gender} + \beta_6 \text{ Food} + \beta_7 \text{ Service} + \beta_8 \text{ Restaurant.}$$

Table 6-2: Logit model of Lugazi firms' willingness to pay for private connections (renters only)

Variable	Description	Parameter estimate	Standard error	P-value
Intercept	N/A	0.96	0.57	0.10
Price	Amount of rent increase (1000s of Shs.)	-0.28	0.07	<0.01
Volume	Current water use per month (liters)	4.44×10^{-4}	1.73×10^{-4}	0.01
Revenue	Firm's reported monthly revenue (USD)	1.82×10^{-3}	9.04×10^{-4}	0.04
Position	1=respondent is owner 0= respondent is manager	-0.18	0.39	0.63
Gender	1= respondent is female 0= respondent is male	-0.35	0.38	0.37
Food	1=firm is foodstuffs seller 0=otherwise	0.28	0.45	0.53
Service	1=service sector firm 0=otherwise	0.40	0.52	0.44
Restaurant	1=firm is a restaurant 0=otherwise	-1.09	0.85	0.20

Table 6-3 provides the results of this model. Again, the price variable is negative and strongly significant; for every 50 Shs. (.04 USD) increase in the price per jerrican, the odds of being willing to pay for kiosk service are expected to decrease by 2.3. The variable representing current water usage, however, is no longer significant. In addition, the gender variable is highly significant in this model--all else held constant, a female respondent is 2.8 times more likely to be willing to pay for kiosk service as compared to a male respondent. One possible explanation for the difference in this variable's significance between the two models is that female respondents better appreciated the benefits that a public kiosk system would confer on women, the traditional water fetchers in Lugazi. Another interpretation might be that women would prefer a water supply technology that would limit their interaction with vendors, virtually all of whom are male. Again, there was no significant difference in the demand for kiosks among different types of enterprises, nor between firm owners and senior managers. Together, these data suggest that MSEs in Lugazi are more interested in having access to a convenient system of public water points than in obtaining private water connections for their businesses. In addition, using mean and median values from the sample of Lugazi firms renting their property, we calculated the predicted probability that a typical firm would make use of either type of improved water supply service. The MSE is a retail dry goods establishment earning monthly revenues of 3 million Shs. (2270 USD), using two jerricans of water per day, and headed by a female owner. This firm has a predicted probability of using a kiosk offering water for 25 Shs. per jerrican of 0.77, but a predicted probability of installing a private connection for 7000 Shs. (5.30 USD) per month of only 0.18. Note that these findings are consistent with the revealed

preferences of firms in Wobulenzi; patronage of the kiosk system is widespread but demand for private connections among MSEs is currently quite low.

Indeed, among those who gave affirmative responses to both willingness-to-pay questions, 57% said they would choose a kiosk system over a private connection if given the option (over all prices). Most of these respondents said they preferred kiosks because they were a cheaper water supply solution given their firms' limited need for water; because they felt public water points would be more effectively maintained; because they preferred a pay-as-you-go payment arrangement; and because they feared additional rent increases by their landlords. The implications of these findings for water infrastructure planning and policy are the subject of the following section.

Table 6-3: Logit model of willingness to pay for kiosks (Lugazi)

Variable	Description	Parameter Estimate	Standard error	P-value
Intercept	N/A	1.93	0.59	<0.01
Price	Price per jerrican at kiosk (Shillings)	-0.02	5.0×10^{-3}	<0.01
Volume	Current water use per month (liters)	2.0×10^{-5}	3.4×10^{-5}	0.55
Revenue	Firm's reported monthly revenue (USD)	-1.8×10^{-4}	7.7×10^{-4}	0.81
Position	1=respondent is owner 0= respondent is manager	-0.27	0.42	0.51
Gender	1= respondent is female 0= respondent is male	1.03	0.42	0.01
Food	1=firm is foodstuffs seller 0=otherwise	0.59	0.47	0.21
Service	1=service sector firm 0=otherwise	0.60	0.56	0.28
Restaurant	1=firm is a restaurant 0=otherwise	-0.09	0.69	0.90

7. Summary of findings

The installation of a piped water network has clearly conferred a range of benefits to small enterprises in Wobulenzi. Returning to the analytical framework outlined in Table 2-1, evidence of several hypothesized short-run impacts was gathered from firm owners and managers during this investigation. The most prominent effect concerns production costs, which have fallen for firms using virtually any volume and source of water. Although expenditures on water supply comprise a relatively small part of most firms' budgets, for many enterprises operating on slim profit margins these cost savings can translate into important economic effects. For example, consider a typical smaller Wobulenzi firm with monthly expenditures of 2,000,000 Shs. (1,515

USD) (net of goods for re-sale) and revenues of 2,080,000 Shs. (1,576 USD) (*i.e.*, profits represent 4% of expenditures). Suppose that, before Wobulenzi's water supply improvements, the firm purchased four jerricans of water per day from a vendor for a total monthly expenditure on water supply of 21,000 Shs. (15.90 USD).[9] If the firm switched to kiosks as its principal source of water and continued to use the same volume of water each month, its monthly water supply expenditures would have fallen to 3,000 Shs. (2.30 USD). This translates into a 24% increase in profit for the firm—an impressive boost for an MSE struggling to grow, and one which would likely have significant impact on its ability to expand. Note that these calculations do not include the value of time spent obtaining water. However, as noted in Section 5, we have reason to expect the effect of such calculations to be small. In addition, as will be discussed below, these benefits of low-cost water to Wobulenzi MSEs are somewhat inflated by subsidies from other consumer groups. Even more modest profit gains, however, would be of benefit to firms.

Almost one fifth of Wobulenzi entrepreneurs also reported that their firms have increased output of goods and services as a result of improved water supply, a sizeable proportion for only a 12- to 18-month time period. Interestingly, these gains appear to have resulted primarily from cost savings, with little contribution from increased reliability of water supply. As noted in Section 4.1, Wobulenzi's piped network is vulnerable to unreliable electric service and suffers frequent breakdowns, thus precluding MSEs from reaping the full benefits of an improved piped water system. Fewer firms reported increased demand for their products, and those who did attributed this effect primarily to using higher quality water in production rather than to increased purchasing power of households. It is notable, however, that little change in water treatment practices has occurred among firms; roughly the same proportion boil their drinking and cooking water, whether from kiosks or other sources.

As expected, evidence regarding longer-term impacts of improved water supply on Wobulenzi MSEs is scant at this juncture. There is no evidence, for example, that firms producing relatively water-intensive goods or services have begun to locate in Wobulenzi in greater numbers since completion of the piped network. Several firm owners and managers did attribute their ability to undertake capital investments or hire additional workers for their businesses to cost savings from water supply, and several have added new, water-intensive outputs to their product lines. It would be necessary to re-visit Wobulenzi in several years in order to assess the extent to which firms have invested in more efficient technology and adjusted their production to exploit the availability of low-cost, higher quality water. We would also expect the nature of commercial and industrial activity to change over time, with relatively water-intensive enterprises choosing to locate in Wobulenzi.

It may also be that this longer-term adjustment in commercial activity is necessary to effect significant increases in the volume of water used by MSEs. We were somewhat surprised to find that, while the majority of firms in Wobulenzi have changed their principal water supply source over the past 18 months, the volume of water used by firms has changed very little. It would be particularly useful to evaluate the extent to which the profile of Wobulenzi firms shifts toward more water-intensive business types over the next few years.

[9] Assuming the firm is open seven days per week and the price paid for a jerrican of vended water is 175 Shillings (see Sections 3 and 5).

In sum, evidence from this research suggests that water infrastructure is an important part of the "enabling environment" for MSEs currently promoted by donors and governments. At the same time, careful planning and implementation of water supply improvements is essential if benefits to firms are to be sustainable. In the next two sections, we review lessons learned in this regard from Wobulenzi and Lugazi.

7.1 Policy lessons: Wobulenzi

Although the majority of firm owners and managers in Wobulenzi were enthusiastic about the effects of improved water supply on their operations, it is important to note that these impacts may be short-lived and to understand why this is so. The Small Towns Water and Sanitation Project utilized a demand-driven planning approach that allowed residents a voice in choosing the water supply technology installed in their community. The decision to allow private connections while also providing 31 kiosks throughout Wobulenzi was based on the notion that wealthier firms and households would install private connections and subsidize poorer residents' access to public kiosks.[10] Over time, rising incomes would result in greater numbers of private subscribers and, eventually, in the de-commissioning of many kiosks. Three subsequent project design decisions together made this strategy unlikely to succeed. First, construction began on the kiosks long before applications were accepted for private connections. Second, the price per jerrican of water at the kiosks—25 Shillings (.02 USD) was set too low. Third, the project did not provide for the financing of initial costs for consumers who desired a private connection.

The effects of these decisions are easy to trace in Wobulenzi. A firm (or household) that might have installed a private connection and thus served essentially as a "private kiosk" to others in its neighborhood was not given the opportunity to do so until the public kiosks were already in place. Such competition would not be problematic if water from the kiosks were reasonably priced. Because of the Water Authority's cross-subsidy scheme, however, kiosks offer 20 liters of water for 25 Shillings (including the cost of the attendant). A private seller would not fare well in direct competition, as s/he would have to pay connection costs of roughly 250,000 Shs., as well as a volumetric charge of 1,000 Shs. (0.76 USD) per cubic meter of water, and would also have to hire an attendant or devote his/her own time to vending water. As a result, once the system of kiosks was in place, only those firms and households for whom the internal consumption of water from a private connection exceeded its costs (and perhaps those located at some distance from a kiosk) would proceed with installation. Our data from Wobulenzi indicate that only a minority of firms currently use enough water to make them candidates for such an investment. Indeed, whereas the Water Authority predicted that 24 businesses would have private water connections by the time of our study, only two did (and two others had submitted applications for connections).[11] One strategy that might have increased subscription rates is the provision of financing for connection costs. All of the firms that we asked about this issue said

[10] The project has a cost-recovery requirement with respect to operation and maintenance only; the initial system construction was completed with grant funds.

[11] Similar disappointments in connection rates have occurred in the residential sector as well; 50 subscribers were projected for January 1999 but only eleven have actually connected. Note that there is no rationing of connections; the Water Authority has simply not received requests (and deposits) from other customers ready to install private connections.

they would be willing to obtain a connection if given the opportunity to spread initial costs over a period of one to three years.

Obviously, as the group expected to subsidize kiosk users is significantly smaller than envisaged, Wobulenzi's entire water supply system is in financial jeopardy. In fact, the Water Authority's director has recently initiated a request to the town's neighborhood water user groups to authorize a 50 to 100% increase in the price of water from the kiosks. If our data from Lugazi can be used as a rough guide, the price per jerrican could easily be tripled without much impact on firms' demand. Although MSEs would not enjoy cost savings as great as those we documented, they would still receive significant reductions in water supply expenditures. Using a 75 Shs. per jerrican price in the hypothetical example above, for example, would still yield a 16% increase in profits to the firm (as compared with a 24% increase using the current price of 25 Shs. per jerrican).

Indeed, had the price at Wobulenzi's kiosks been set at a more reasonable level from the outset, one could imagine a different and more resilient water sector for the town. Firms and households able to take advantage of the opportunity to become "private kiosks" would have installed private connections at full cost, perhaps reducing the amount of public investment in kiosks that was needed. The financial health of the Water Authority would be less vulnerable to miscalculations in subscription rates of different consumer groups. Firms and households, while enjoying less cost savings on water supply, would nevertheless benefit from high quality, affordable service that was also financially sustainable. More importantly, the kiosks would serve the transitional role originally envisioned for them, rather than impeding progress toward a community served largely by private water connections in businesses and homes.

7.2 Policy lessons: Lugazi

Given this review of water supply planning experience in Wobulenzi, one might conclude that priority in Lugazi (and other secondary towns with unimproved water service) should be given to providing private water connections to firms and households. If there were sufficient demand for this level of service, such an approach would be appropriate. However, we found that demand for private water connections among Lugazi firms was very low (Section 6.1).[12] Even absent the influence of competing, low-cost water sources (as in Wobulenzi), it appears that MSEs in Lugazi are simply not interested in obtaining private connections at this time, even at prices roughly equivalent to their current expenditures on water supply. This result is particularly striking given that the majority of respondents were told they would bear none of the initial connection costs and would pay only a monthly fee for service. On the other hand, demand for a system of kiosks was very strong, even at per-jerrican prices five times higher than those currently offered in Wobulenzi. MSEs in Lugazi clearly prefer a system of public water points to private connections at this time.

[12] We have conducted research on the demand for private connections by households in Lugazi, however, and concluded that demand for private connections among domestic users is significantly greater as compared to firms. See Whittington, D., J. Davis, and E. McClelland (1998).

There are many reasons why small enterprises in Lugazi (and Wobulenzi, for that matter) may not be willing to pay for private water connections. First, many operate on rented property and may feel that installing a yard tap could pose an additional source of conflict with their landlords. Anecdotal evidence suggests that relationships between firm owners and their lessors are frequently strained, and a strong legal framework to enforce rental agreements in such communities appears to be lacking. Second, many MSEs currently use a very small volume of water, and a large proportion of those interviewed felt a private connection would provide more water than their firms could use. (Over time, of course, one would expect not only existing firms to alter their operations in order to take advantage of the availability of lower cost, higher quality water, but also that firms using water-intensive processes would locate in towns where such service is available.) Third, many MSEs in these towns operate on extremely narrow margins. Several respondents in our survey said they prefer to pay for inputs on a unit basis whenever possible, in order to avoid large debts at the close of each month. Fourth, many MSEs interviewed are quite young, perhaps indicating that the life span of firms in these towns is limited. Entrepreneurs may not want to undertake responsibility for a piped water connection if they view their business to be of a temporary nature.

In one sense, planners in Lugazi are faced with a situation not unlike the one in Wobulenzi a few years ago. Their challenge is to respond to consumers' current demand for improved water supply services while also designing a system that can evolve with changing preferences over time, as incomes rise and economic activity increases. We have argued in an earlier paper that responding only to current demand in communities like Lugazi will impede water resources development over the long run. This indeed appears to be occurring in Wobulenzi.[13] If planners in Lugazi are to avoid similar errors, it seems clear both that (1) firms' preferences for public water points, rather than private connections, should form the basis for planning of the downtown commercial area, and (2) water sold from a kiosk system must be priced at economically feasible rates. This strategy would encourage those firms and households willing and able to pay the full costs of a private connection to do so, but also allows the viability of the kiosk system to be determined by market forces over the long run.

This approach is at odds with some conventional water infrastructure planning strategies that emphasize the town center as the key to modernizing service delivery. With these strategies it is thought that upgrading the downtown with a piped network and private connections will be relatively more affordable to centrally located commercial establishments and residences, who are assumed to have greater ability to pay for improved services. Improving service to the city center is also thought to be an effective means of encouraging economic development, as this area is the most likely to be visited by outsiders. Our findings suggest that this vision of water supply modernization may not be successful in towns like Lugazi and Wobulenzi, where firms currently have little felt need for large volumes of water and more affluent residential neighborhoods are located outside the city center.

7.3 Directions for future research

It is worth noting once more that one of the principal objectives of this research was to develop a methodology for use in assessing the value of water supply infrastructure to small enterprises in

[13] Whittington, D., *et al.* , op cit.

sub-Saharan Africa. Ours was an exploratory study that, while testing several *a priori* hypotheses regarding the relationships between firm operations and water supply characteristics, devoted significant attention to the methodological approach and the collection of high-quality data from respondents. We are encouraged by the facts that virtually all MSEs in Wobulenzi and Lugazi agreed to discuss their operations with our enumerators; that the data collected appear meaningful and internally consistent; and that we were able to develop models of firms' existing behaviors and stated preferences for water supply improvements that yielded important, policy-relevant insights.

As noted in Section 7.1, our visit to Wobulenzi only one year after the installation of an improved water supply system means that many of the hypothesized longer-term effects of improved water supply on MSEs could not be evaluated in this study. Our work provides an important baseline for a return to Wobulenzi after another few years. Not only can the activities and profitability of firms that existed prior to the improved service be more fully evaluated, but an assessment of changes in the commercial and industrial landscape of the town can provide important evidence regarding the role of water supply infrastructure as an engine of economic development.

It is also essential to evaluate the impacts of improved water supply on a variety of firm sizes and types, as well as on firms in a variety of settings. We can imagine that, while the general framework of effects hypothesized in Section 2 should hold over all these different conditions, the relative importance of particular impacts will vary considerably. Thus, medium and large firms, as well as enterprises in more urban communities and across a number of countries, should be included in a larger investigation that allows for more robust and generalizable conclusions.

Finally, our focus on water supply infrastructure in this investigation was in part a response to the dearth of knowledge about the importance of water supply to MSEs in developing countries. Certainly the benefit of improved water infrastructure relative to other types of MSE support is an important area for future research, as donors and governments would like to use their limited resources to greatest effect for small businesses.

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